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THE BOTANICAL GAZETTE

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CONTENTS:

Note on Phallogaster saccatus. (With plate IX.)—*Roland Thaxter* . . 117
The genus Cæsalpinia.—*E. M. Fisher* 121
The tendrils of Passiflora cærulea. (With plate X.)—*D. T. MacDougal.* 123
The limitation of the term "spore."—*Conway MacMillan* 130
The range of variation in species of Erythronium. (With plate XI.)—*M. E. Meads* 134
Noteworthy anatomical and physiological researches 138
Anatomy of the tubers of Equisetum.—*Theo. Holm.*
Yeast fungi.—*J. Christian Bay.*
Soluble pentoses in plants.—*J. Christian Bay.*
Briefer Articles 141
Description of a new fossil species of Chara.—*F. H. Knowlton.*
Is Cypripedium spectabile poisonous to the touch?—*H. G. Jesup.*
The pine grosbeak's attack on the ashes and spruces of Cambridge, Mass.—*Walter Deane.*
Editorial 144
Current Literature 146
Open Letters 151
That "probably carnivorous" Polyporus.—*Conway MacMillan.*
Notes and News 151

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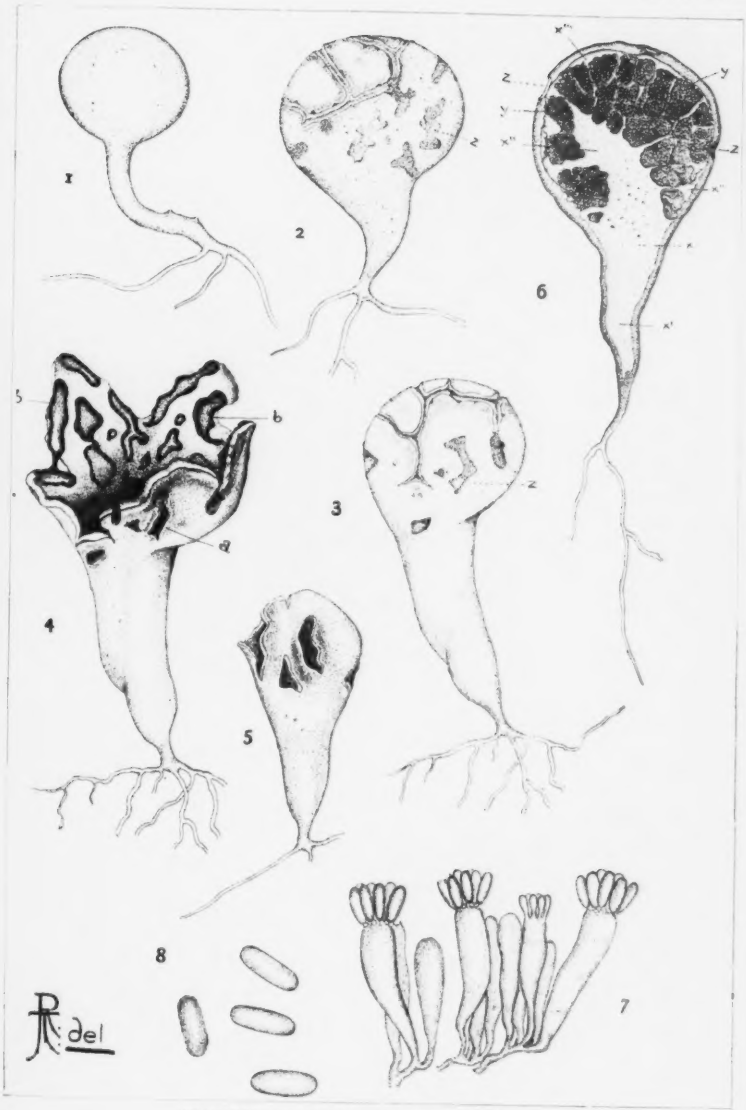
In the May number will appear:

Contribution to the biology of the organism causing leguminous tubercles, by DR. GEORGE F. ATKINSON, *Cornell University.*

The genus Corallorhiza, by PROF. M. B. THOMAS, *Wabash College.*

On two new or imperfectly known Myxomycetes, by DR. W. C. STURGIS, *Connecticut Experiment Station.*

Frost freaks of the dittany, by LESTER F. WARD, *U. S. National Museum.*



THAXTER on PHALLOGASTER SACCATUS.

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BOTANICAL GAZETTE

APRIL, 1893.

Contributions from the Cryptogamic Laboratory of Harvard University. XIX.

Note on Phallogaster saccatus.

ROLAND THAXTER.

WITH PLATE IX.

During the past season the writer was so fortunate as to meet with the singular genus of *Phalloideæ* recently described by Mr. Morgan under the above name, as well as to observe its final development in connection with its earlier conditions; and since the description above referred to seems to indicate that the material on which it was based was somewhat immature, the publication of the present note seems desirable to supplement the original account. Through the courtesy of Mr. Morgan the writer has been able to compare an authentic specimen of *Phallogaster* with his own material and to determine their identity, although, as will be observed, the account here given involves some modification of the original description.

The genus presents so remarkable a departure from the type of structure common both to the *Phalleæ* and the *Clathreæ*, through the absence of any volva or receptacle differentiated as such in the mature condition, that it may not only be properly placed by itself as the type of a third subdivision of *Phallogastreæ*, but involves a distinct modification of the generally accepted definition of the family as a whole, in which its affinities are evidently rather with the *Clathreæ* than with other members of the group. Its structure is remarkably simple in a family peculiar for structural eccentricity, and, as stated by Mr. Morgan, appears to connect the phalloids more closely with the *Lycoperdaceæ* than any form hitherto discovered.

The sporophore in the present genus arises, like that of its allies, from a branching rope-like mycelium, running on or below the surface of the ground or decaying wood on which

it grows, and, though sometimes sessile, is usually raised upon a more or less clearly defined stalk, which, not infrequently, is abruptly distinguished from it (fig. 1). In section it is seen to consist (fig. 5) of a central portion, x, highly gelatinous even in young specimens and extending downwards, x', into the stalk, while above it forms a more or less well defined central axis, x'', surrounded laterally and superiorly by the gleba which it penetrates in all directions, not only separating and entering its main lobes, but extending to the peridial wall within which it forms a continuous layer, x''', separating these two structures, except at definite points, y, where they are closely united. This gelatinous portion is composed of rather slender hyphae, branching and intertwining irregularly, among which numerous vesicular clamp-connections are conspicuous, one or both of the adjacent cell ends at such points being abruptly and very considerably inflated.

The gleba, the color and minute structure of which is similar to that of other phalloids, is irregularly lobed, and, as just mentioned, is separated from the peridial wall by a gelatinous layer continuous with the other gelatinous elements. This layer is, however, interrupted at irregular intervals by certain slightly projecting areas of the inner face of the peridial wall. These prominences, which are often ill defined and are irregular in size and outline, show no signs of any differentiation which might suggest the first step towards the formation of a receptacle proper, although the gleba is continuous with them and adheres to them after its deliquescence in clearly defined aggregates (fig. 4).

The peridial wall is moderately thick and clearly distinguished from the elements contained within it. In section it is seen to be formed by a thick layer of branching septate hyphae, the successive cells of which are irregularly inflated, forming eventually a rather loose pseudo-parenchyma which is covered externally by a very thin cortical layer, composed of slender cylindrical brownish hyphae and ill defined or scarcely distinguishable at maturity, although in the youngest specimen observed, measuring 7^{mm} in diameter, it is more prominent, as would naturally follow from its origin as a continuation of the mycelial cortex. The inner face of the peridial wall is beset with prominences irregular in outline and extent and at intervals wholly absent. Seen in section certain of these prominences coalesce with the gleba lobes, while others are bounded by the gelatinous layer already referred

to as separating the gleba from the peridium. The peridial wall, moreover, does not form a homogeneous and unbroken layer, but is singularly modified by the presence of numerous depressed areas (figs. 2, 3, 6, *z*), irregular in size, shape and position, giving the surface in many specimens an irregularly reticulated appearance, which, though less distinct in fresh material, becomes well defined when the wall is slightly shrunken by drying or by treatment with alcohol. These depressions, which constitute one of the most striking peculiarities of the form in question, are filled with loosely woven more or less shriveled brownish hyphae, and do not appear to represent a special differentiation of the wall, but to have resulted from the death or non-development of its hyphae at such points during the earlier period of its growth. The function of these depressions becomes manifest when the fungus has reached maturity. At this time dehiscence takes place in two ways. In smaller specimens the peridium may become irregularly clathrate through the perforation of its wall where these areas occur, the openings being enlarged through the outward curvature of the surrounding edges (fig. 5). More frequently, however, this perforation is associated with a general dehiscence at the apex (fig. 4), first indicated by the appearance of a series of cracks in this region (figs. 2, 3), the course of which is guided to some extent by the depressed areas just described. The peridial wall thus ruptures in an irregularly stellate fashion, into several segments, which, separating from one another and becoming divergent or slightly reflexed, expose the interior surface. At the same time the larger of the depressed areas which have not been included in this cracking may become perforate (fig. 4, *a*). Meanwhile the entire contents of the peridium has become deliquescent, the main lobes of the gleba contracting and adhering to the inner face of the peridium in the form of clearly defined slimy masses, of irregular size and shape (fig. 4, *b*). In this condition the expanded funnel-shaped peridium is hollow to its very base and has assumed the function usually accomplished in the group by means of a highly specialized receptacle, exposing to the air the fetid spore masses, the removal of which is, as usual, rapidly accomplished through the agency of flies, leaving an empty shell which soon collapses and decays.

It should perhaps be mentioned that the depressed areas and resultant perforations of the peridial wall, which, as far

as can be determined from the material at hand, do not find a parallel elsewhere in the family, appear to bear no definite relation to the areas on the inner face of the peridial wall, upon which the gleba lobes are seated, including them or not without regularity.

The question of homologies between this and other phalloid genera may well be deferred till its earliest conditions are exactly known; meanwhile it would be perhaps more easy than profitable to point out by what modifications we might readily convert it into something very like the genus *Clathrus*.

In view of the above history the original diagnosis of the form may be modified as follows:

PHALLOGASTER Morgan.—Mycelium fibrous, branching. Peridium spherical to pyriform, stipitate or substipitate, consisting of a single layer covered by an evanescent cortex and coarsely reticulated through the presence of numerous irregular thin areas which become perforate at maturity, the perforation commonly associated with a general terminal dehiscence of the peridium into several divergent lobes. Gleba irregularly lobed, the lobes continuous with slight prominences from the surface of the peridium from which they are elsewhere separated by a gelatinous layer continuous with a central gelatinous axis which penetrates the gleba and separates its lobes. The entire contents deliquescent at maturity, adhering in distinct masses to the inner surface of the ruptured peridium.

PHALLOGASTER SACCATUS Morgan: Journ. Cincinnati Soc. Nat. Hist. XV, 171, plate II, Oct. 1892.—Plate IX. Solitary or rarely subcespitose. Peridium spherical to pyriform, 20–50 × 10–25^{mm}, stipitate or nearly sessile, the surface smooth, slightly uneven, whitish stained with dull flesh-color at maturity, becoming coarsely clathrate from the formation of irregular perforations, the perforation usually associated with a terminal dehiscence of the peridium into from three to five divergent lobes: the dark sage-green gleba adhering in definite masses of irregular size and shape to the inner face of the peridial wall. Spores greenish, sub-cylindrical 4–5.5 × 1.5–2μ, 6–8 on each basidium.

Ohio (*Morgan* and *Herrick*). New York and Connecticut (*Underwood*). Maine (*Thaxter*) on the ground or rotting wood under Fagus.

Harvard University.

EXPLANATION OF PLATE IX.—*Phallogaster saccatus* Morgan. Fig. 1. Stipitate habit. Fig. 2, 3. Appearance just before dehiscence showing cracks at apex and thin areas *z*. Fig. 4. The same specimen as fig. 3, after dehiscence. *a*, perforate thin areas. *b*, deliquesced gleba masses adhering to inner face of peridial wall. Fig. 5. Smaller example which has become perforate without complete dehiscence. Fig 6. Longitudinal section of a mature specimen before dehiscence. x, x', x'', x''', gelatinous axis and its derivatives, *y* points of origin of gleba from peridial wall. *z*, thin areas in peridial wall. Fig. 7. Basidia with spores *in situ*. Fig. 8. spores.

Figs. 1-6 about natural size. Fig. 7, drawn with Leitz 1-12 oil immersion, Zeiss ocular 4. Fig. 8 Leitz 1-12 oil im. Zeiss comp. oc. 12.

The genus Cæsalpinia.

E. M. FISHER.

Following the publication of my revision of the genus *Hoffmanseggia* in Contributions National Herbarium, I. no. 5, I desire to make certain corrections and supplementary statements.

On page 144, §1, line 1 of synopsis, the reference should be to no. 2 (*H. drepanocarpa* Gray) not no. 4 (*H. gracilis* Watson).

Since *nomina nuda* are not to be recognized, *H. glabra*, var. *intricata* Fisher should read *H. intricata* Brandg.; and *H. glabra* Fisher should read *H. intricata*, var. *glabra* Fisher.

It may be well to speak of the combination *H. falcaria*, var. *demissa* Fisher. Dr. Gray, in 1852, published in Pl. Wright., in the following order, *H. densiflora* Benth. MSS., *H. stricta*, var. *demissa* Gray, and *H. stricta* Benth. MSS. *H. densiflora* Benth. is described incompletely, the fruit being wanting, and Dr. Gray remarks that he is not sure that it is distinct from the next form, *H. stricta*, var. *demissa* Gray. From an examination of the types, I concluded that *H. densiflora* is intermediate between *H. stricta* Benth. and *H. stricta*, var. *demissa* Gray. Dr. Gray's remark is sufficient to show that he doubted whether they should be separate, and his unwillingness to publish the var. *demissa* as a species (although having mature fruit) shows which he considered to be the type. Unfortunately in this case, however, the rules of nomenclature demand that *H. falcaria*, var. *demissa* (Gray) Fisher be changed to *H. falcaria*, var. *densiflora* (Benth.) Fisher.

At the time of writing the revision, it was with hesitation that it was not merged with *Cæsalpinia*. After a careful examination of the flowering parts and their tissues, in several species

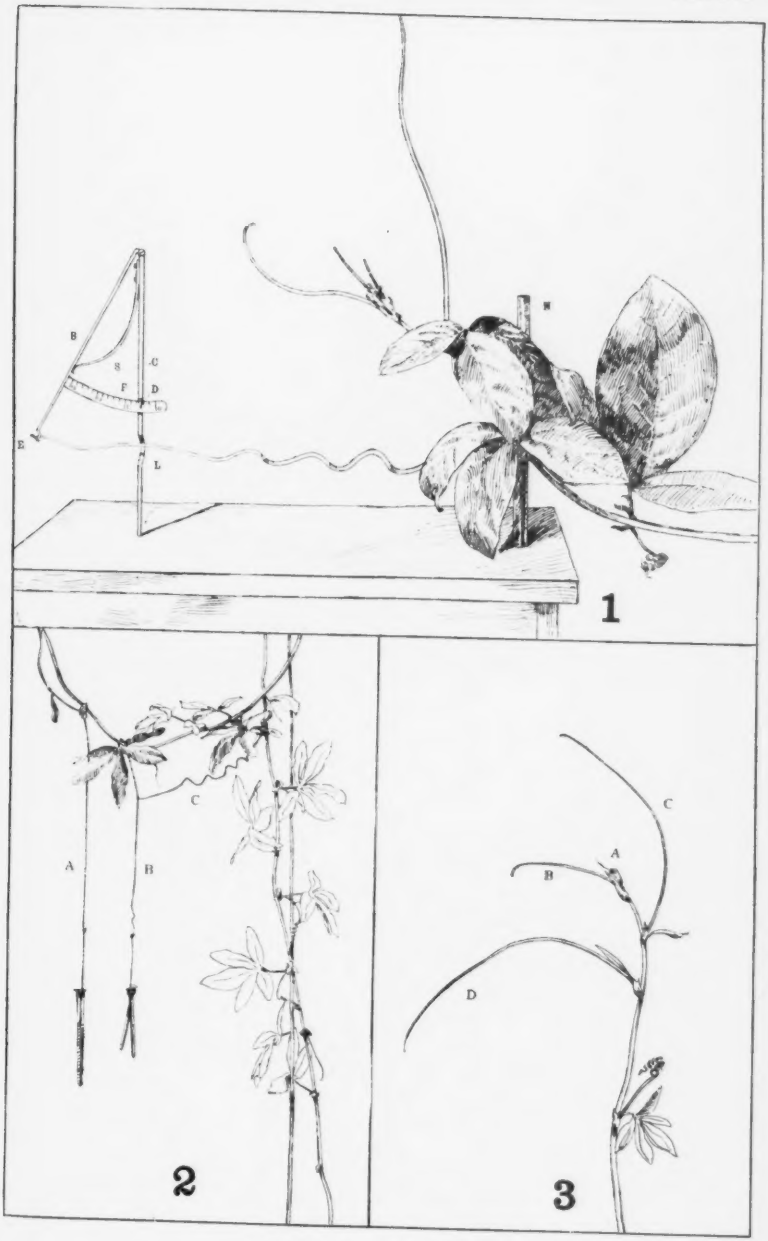
of both genera, I have come to the conclusion that they must be united, even if extreme species in the two genera seem to be so unlike each other. *Hoffmanseggia caudata* Gray has more the characters of *Cæsalpinia Palmeri* Watson than any species of its own genus. Its broad oval sepals, short-clawed elliptical petals, glandless filaments, and broadly ascinaciform pod, are characters which bring it very near *C. Palmeri;* while the stipitate and black sessile glands, ovate bracts, deciduous sepals, and somewhat declined stamens, place it in an intermediate position between *Hoffmanseggia* proper, and *Pomaria.*

Bentham and Hooker have placed *Pomaria* in *Cæsalpinia* (which seems to differ from Torrey and Gray's idea), and then, speaking of *Hoffmanseggia*, say: "The genus scarcely differs from *Cæsalpinia* § *Pomaria* in habit, the sepals less imbricated and the legume thinner."

At first sight *H. falcaria* Cav. seems distinctly separate from any species of *Cæsalpinia*, but following my classification through this section to *H. intricata* Brandg., we pass to *H. caudata* Gray, and very naturally approach the section *Pomaria.* The black glandular section is very near *Pomaria* (according to Benth. and Hook.) the legumes taking on characters of *Guilandina*, *Sappania*, etc.

Considering all these relations, and the impossibility of establishing any sure generic distinctions, since there are intermediate forms which bridge all proposed distinctions, I am compelled to follow Baillon and place our species of *Hoffmanseggia* under *Cæsalpinia.* The necessary changes in our North American species are as follows:

1. C. FALCARIA: *H. falcaria* Cav.
   - Var. STRICTA: *H. falcaria*, var. *stricta* (Benth.) Fisher.
   - Var. DENSIFLORA: *H. falcaria*, var. *demissa* (Gray) Fisher.
   - Var. RUSBYI: *H. falcaria*, var. *Rusbyi* Fisher.
   - Var. PRINGLEI: *H. falcaria*, var. *Pringlei* Fisher.
   - Var. CAPITATA: *H. falcaria*, var. *capitata* Fisher.
2. C. DREPANOCARPA: *H. drepanocarpa* Gray.
3. C. OXYCARPA: *H. oxycarpa* Benth.
4. C. WATSONI: *H. gracilis* Watson (1882), not Hook. & Arn. (1841).
5. C. GLADIATA: *H. gladiata* Benth.
6. C. PLATYCARPA: *H. platycarpa* Benth.



MacDOUGAL on PASSIFLORA.

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7. C. DRUMMONDII: *H. Drummondii* Torr. & Gray.
8. C. TEXANA: *H. Texana* Fisher.
9. C. VIRGATA: *H. microphylla* Torr. (Specific name preoccupied under *Cæsalpinia*.)
10. C. INTRICATA: *H. glabra* Fisher, var. *intricata* (Brandg.) Fisher.
    Var. GLABRA: *H. microphylla* Torr., var. *glabra* (nomen nudum) Watson. *H. glabra* Fisher.
11. C. CAUDATA: *H. caudata* Gray.
12. C. BRACHYCARPA: *H. brachycarpa* Gray.
13. C. MULTIJUGA: *H. multijuga* Watson.
14. C. MELANOSTICTA: *H. melanosticta* (Schauer) Gray.
    Var. PARRYI: *H. melanosticta*, var. *Parryi* Fisher.
    Var. GREGGII: *H. melanosticta*, var. *Greggii* Fisher.
15. C. CANESCENS: *H. canescens* Fisher.
16. C. JAMESII: *H. Jamesii* Torr. & Gray.
17. C. FRUTICOSA: *H. fruticosa* Watson.

There also may be added the following South American form, from U. S. of Colombia, that has come under my observation, and which may possibly extend to the isthmus:

18. C. VISCOSA: *H. viscosa* Hook. & Arn.

Indiana University, Bloomington, Ind.

The tendrils of Passiflora caerulea.

D. T. MAC DOUGAL.

WITH PLATE X.

II. External phenomena of irritability and coiling.

In the preceding paper[1] attention was called to the more apparent features of the development, minute structure and arrangement of the tissues, with a view to determining their value as factors in the coiling movements consequent upon irritation of the lower surface during the period of normal activity of the organ. The results recorded in this and the preceding paper were obtained by the study of plants in the green-house of the Purdue Experiment Station,[2] during the

[1] BOTANICAL GAZETTE, XVII, 205.

[2] I am indebted to Dr. J. C. Arthur for his kindness in placing at my disposal the facilities of the green-house, laboratory and apparatus, and in giving me the use of his private library, together with much valuable advice. I am also under obligations to Miss Katherine E. Golden, Assistant Botanist, for material aid.

months January—April, and September—December, 1892. The observations were extended to include *P. Pfordti* of the gardeners. The temperature varied between 16 and 35°C.

It is of interest to note that both of these forms exhibited marked nutation of the terminal internodes of the stem, since in the species examined by Darwin such was found to be the case only in *P. gracilis.*[3]

This circumnutation of the tendril and the internode bearing it begins when both are quite rudimentary (fig. 3). These movements with the individual movements of the yet immature internodes below combine to sweep the tendril through a large space during its period of greatest activity, thereby greatly increasing the probability of coming in contact with some object which may serve as a support. While this correlation is an obvious advantage, yet it must be borne in mind that nearly half the time the tendril is waving through the air with its non-sensitive surface forward, and hence could not grasp a support should it meet one. It is not necessary to suppose, however, that the tendril has reached the stage of the highest possible usefulness to the plant.

When the moving tendril, after it has attained a length of 4 or 5^{cm}, brings its sensitive surface in contact with an object which acts as a stimulus, a curve is formed at the point of contact in a time varying from 30 seconds to 2 minutes. If this happen in the early stages of growth, the curve is slight, the tissues are weak, and the tendril is dragged past or away from the support. Should the tendril have reached an approximately mature stage, the curve will be formed more rapidly, and the strengthened tissues hold the hook form given to it, and curve still further around the object. If we strike a rigid pole with a rattan cane, the curve formed will be similar to that of the young tendril, and if we strike the pole with a rope one end swinging free, the curve of the mature tendril will be obtained.

In this connection it was thought important to note to what extent the tendril would respond to various kinds of stimuli. Drops of water at ordinary temperature thrown either gently or forcefully against the tendrils produced no curvature. The contact of the ordinary metallic salts acted similarly. But if the tendril were submerged in these liquids the induced osmotic action quickly caused curves.[4]

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[3] Climbing Plants, p. 153. Vines: Phys. of Plants, p. 486.

The contact of mercury was without effect,[5] but if the meniscus of a vessel of mercury be brought forcibly against the tendril, distinct curvatures resulted.

With solids, however, it was found that it would respond to a contact as light as that made by a piece of no. 40 cotton thread, 1^{cm} in length. The results of contacts from objects of glass, woods, metals, stones, fibres, parts of its own and other plants were practically alike, and the rapidity and amount of response depended altogether upon the force of impact and roughness of the surface rather than the composition of the body. No extended experiments were made with electrical stimuli, but no results were obtained by the use of the current from a Leclanché cell.

If the temperature of the water in the previous experiment were raised to 40°C. curves were produced; or if a small rod heated to 50°C. were held near the tendril like results followed. If the water were in the form of snow or ice no curvatures could be obtained, although the hard crystals must have given a very distinct mechanical contact. The results from these high and low temperature stimuli are doubtless due to their direct influence on the osmotic action of the cells, since in the experiment with the heated rod the tendril can be made to curve backward.

Darwin notes that the tendrils of *Bryonia dioica*, and also *Echinocystis lobata*, would not form curves when mutually interlocked. His generalizations can not be extended to the species of Passiflora examined. If a small portion of an excised tendril be placed on an active tendril a temporary curve results, and it was noticed that two tendrils brought against each other almost always formed curves, and the fact that they did not always interlock was due to the fact that both were in rapid motion in opposite directions, and were quickly dragged past. Should any of the tendrils be fixed taut the other may coil around it as has been demonstrated numerous times (fig. 2, c). In one case five tendrils formed a mass of mutual coils. The tendril has also been noted to grasp and crush into a mass in its coils the leaves of its own body, perhaps the one from its own axil. Such action could not even remotely be of any use to the plant, and in view of these facts it is

[4] Botanical Gazette, xvii. 207.

[5] See also Pfeffer: Untersuchungen aus dem Botanischen Institut zu Tübingen, i. 491.

impossible to ascribe to them any great degree of selective intelligence.

The tendrils can coil in such manner as to fasten to almost any object except a polished plane surface. If the object be a cord or a twig the free end coils around it as in the rope experiment, while the portion between the plant and the support is thrown into spiral coils. If a board whose width is nearly equal the length of the tendril be placed in contact with it, the tip will hook around the farther edge while a few spirals are formed which lie flat on the surface. Thus it will be seen that the size of the object which may be grasped is limited only by the length of the tendril, while it can grasp an object however small since the tendril can coil so closely as to obliterate the central enclosed space. This adaptation was still further shown by the manner in which it fastens to the crevices of a brick wall. In doing this the tendril tip finds its way into the small surface cavities of the bricks and forms coils, filling up the cavity in such manner that it can not be dislodged without rupturing the tissues.

Tendrils thrust into smooth glass tubes 2^{mm} in diameter formed curves throughout their entire length, while the more flexible tip formed a solid spiral completely filling up the bore of the tube. It required a force of $10–20^{gm}$ to dislodge such tendrils. Still others placed in tubes scarcely larger than themselves could not be withdrawn without breaking or crushing the tube.

If a tendril during its period of irritability does not come in contact with any object reacting as a stimulus, it will, on completing its growth, slowly form into a continuous right or left handed irregular spiral.

Should the tendril grasp some object with a portion of its tip, the portion in contact with the object grows slightly in length and by its manner of curvature forces its tip farther around the object if it is not too large, and at the same time increases the thickness of the part in contact, as a reactive result of the pressure. The tendril may grasp an object any time during its period of activity, but the part between the support and base will not form spirals until it has attained its maturity, which is from a few hours to two days later. Now the immediate cause of coiling is the inequality of length of the upper and lower sides of the tendril. How this inequality is brought about need not concern us at this point. If the tendency to curve were strongest at the tip and decreased to

zero at the basal portion, the free tendril would coil in the form of a helix and no torsions would result. The strength of the curving power, and of the tendril, are so proportioned that the resulting spirals are all 0.3^{cm} to 0.5^{cm} in diameter and can not lie concentrically, but must form side by side. This means, of course, that torsions are set up. In the free coiling tendril it can revolve and relieve these torsions. In the tendril fastened at both ends, however, this is impossible and if the spirals were all in one direction the torsion would be great enough to work serious injury. The fastened tendril begins to form spirals either near the base or the support on reaching maturity. This part coiling with its spirals all in one direction of course twists the contiguous straight part of the tendril. This twisting continues until the induced torsion is stronger than the coiling force of the first part, and then the twisted part forms coils in the opposite direction in obedience to its own torsion. The portion in which the two forces are equalized will be nearly straight. The remainder of the uncoiled tendril is acted upon similarly until it is coiled in two to seven portions separated by straight parts. The number of the portions will be determined by the relative value of the coiling force and the resistance of the tendril. While the number of spirals in any portion may not be the same as in another portion of the same tendril yet the total number of turns in either direction are invariably equal. The time elapsing between fastening to a support and the formation of spirals leads to the conclusion that the latter is not a direct result of irritability, but rather a function of the mature tendril.

When a straight tendril fastens to a support and afterward forms spirals in the portion between its base and the support, it must tend to bring these two points nearer, unless the tendril has at the same time a growth in length to compensate for the spirals, such as was found to be the case in Cucurbita by Penhallow.[6] Extended observations were made to determine if the distance between the base of the tendril at the body of the plant and the support were brought any nearer, and if so what force was exerted in so doing. Repeated measurements disclosed the fact that the tendril drew the portion of the vine near its base toward the support a distance of 1 to 6^{cm} or as much as one-third its length.

Weights of three grams upward were suspended from the

[6]Canadian Record of Science, II. 242. Oct. 1886.

tips of tendrils by means of loops of soft cotton cord to determine their lifting strength. With weights less than six grams many close spirals were formed lifting the weights several centimeters. With the increase of weight, more open spirals resulted. Still higher only weak curves were made, while tendrils weighted with twenty grams were held entirely straight, and this may be safely taken as the limit of the lifting power (fig. 3). These effects, however, are modified by effect of the traction of the weights on the tendril.[7]

The results obtained by the dynamometers are doubtless of greater value. Of these, three types were used. One form consisted of a spiral spring of brass suspended from a hook in an upright wooden standard after the manner of the Joly gravity balance. The tendril is fastened to the lower end of the spring and the amount of tension determined by an arbitrary scale. The second form was the lever dynamometer which is in general use and needs no description here.[8]

The most satisfactory results, however, were obtained from the use of Vöchting's dynamometer.[9] This machine is designed for use with a clinostat, but can be used in determining tensions of all kinds. It is simple, convenient and reliable. (See plate X.) It consists essentially of two compass arms of metal 10^{cm} and 6^{cm} in length, separated by a spring (s). The long arm (c) carries the spring and the short pointer (d) and is curved back a short distance below the pointer (l) and tapers uniformly throughout to the lower end which is a sharpened point. The shorter arm (b) joins the longer arm by an ordinary hinge joint. This arm tapers to the lower end, terminating in a small hook (e), and carries the arc scale (f) which slides under the pointer. The scale is marked into fifteen divisions so arranged that a pull on the hook (e) will be indicated in grams by the pointer. The spring (s) is made of gold for greater reliability, and is fastened to the long arm by two small screws. The other end slides freely along the shorter arm as the pressure varies. In the plate the machine is shown registering a tension of $2\frac{1}{2}^{gm}$ of a tendril of *Passiflora Pfordti*.

The plant at the base of the tendril is attached by cords to an iron post (n) driven firmly in a board. The long arm of the dynamometer is driven into the board in such position that

[7] W. Pfeffer: Ber. Verhandl. K. Sachs. Gesell. Wiss. v. 638–643. (1892.)
[8] Pfeffer: Die periodischen Bewegungen der Blattorgane, 1875.
[9] Berichte der. deutchen bot. Gesellschaft, VI. 279. (1888).

the straight tendril will pass the curved portion without touching, and catch the hooked end of the short arm with its curved tip. Any tension set up is indicated directly on the scale. The tendrils tested with this type of dynamometer exhibited tensions of 3 to 10^{gm}.

The function of the tendril is doubtless to pull the growing shoot up toward the light and fix it to a support. It occupies a supra-axillary position and the internodes are from 3 to 10^{cm} in length. The work of each tendril as it in succession comes to maturity is to lift its internode and the undeveloped internodes of the growing shoot. On testing it was found that this portion of the plant never reached a weight of 1^{gm}, and the amount to be lifted by two adjoining tendrils rarely exceeds 1.5^{gm}. Thus it will be seen that each tendril is capable of doing the work of many. The value of this provision is apparent when it is known that not all of the tendrils are able to reach supports, others are injured or rendered incapable of grasping objects by the force of the winds, and that the firmness with which a plant is held has a direct influence on its growth.

The coiling of the attached tendrils and the subsequent strengthening of their tissues give them the elasticity of springs and enable them to withstand severe shocks and strains without injury. The force required to tear a plant from its supports must first straighten the coils and then rupture the tendril. No measurements were made of the tensile strength, but it was found that normally coiled and mature tendrils required a force of 350 to 750^{gm}—the weight of several feet of the plant body—to break them, so that the probability of a vine, firmly anchored by dozens of these tendrils, being torn from its fastenings, is very remote.

Briefly summarized, the tendrils and terminal internodes of the two species of Passiflora examined show circumnutation. The tendrils are sensitive to contact of solids, and liquids at a temperature of 40°C., and are non-sensitive to liquids at ordinary and low temperatures, unless they are so applied as to induce direct osmotic action, and to slight electrical stimuli. Coiling around an object takes place on contact, while formation of spirals takes place on maturity. The formation of the spirals exerts a tension of three to twenty grams, shortening the tendril one third of its length, and a mature tendril can withstand a strain of 350 to 750^{gm}.

Purdue Experiment Station, La Fayette, Indiana.

EXPLANATION OF PLATE X.

Figure 1. *Passiflora Pfordti;* Vöchting's dynamometer attached to tendril; B, short arm, C, long arm, D, pointer, E, hook, F, scale, L, curve of long arm, S, spring, N, iron post.

Figure 2. *Passiflora cærulea;* A, tendril carrying weight of nineteen grams, slightly curved near base, B, tendril carrying weight of nine grams, spiral near tip, C, tendril grasping tendril B, which it has pulled from the perpendicular.

Figure 3. *Passiflora cærulea;* A, growing tip of shoot with undeveloped tendrils, B, tendril slightly sensitive and nutating, C, tendril capable of coiling, D, tendril nearly mature—in the period of highest activity.

The limitation of the term "spore."

CONWAY MAC MILLAN.

Every one who has attempted to define his terms of daily use has probably met with the same experience that the writer might describe. Words, easily definable at first, become more and more vague as their implication is more fully understood. In view of the scantiness of botanical terminology, although it is one of the richest of scientific vocabularies, there is great need that the import of common terms should be examined with much care to avoid the errors of over-, or under-definition. Every work that appears presents some new and generally barbarous verbal technicalities that tend rather to cloud than to clarify perception, For example in that most excellent little compendium on the cryptogamic plants, lately published from Bennett and Murray, one is grieved to find that the word "sperm," properly employed in plant, as in animal, biology, is diverted to a peculiarly unnecessary meaning and is taken as a synonym of the phrase "fertilized egg," when it would have been much preferable to unify the terminology by calling the antherozoid of the plant a "sperm," and thus recognizing what it is necessary to recognize as fully as may be that the animal and the plant are alike, for the higher groups of organisms, in producing sexual cells and that these cells are, even in their intimate mitotic phenomena of development, strictly analogous, if not absolutely homologous.

At present I wish to speak in particular about the use of the word "spore" in botanical writing, and it is not intended to offer any historical or highly exhaustive discussion at this time, but simply to show how under the general term there are a number of ideas that clear thinking demands should be kept separate. In the first place it may be noted that the

term spore is not used here as having any connection with the so-called "oospores" of the books, for they are surely better given some other name, since they are products of gametic union. The same may be said of the "zygospores" of the Conjugatæ. The word is therefore limited here under the well known definition, "a spore is an originally perfect cell specialised for purposes of reproduction."

Nor is it intended to examine the various categories of spores which present in their terminology some idea of their formation, as for example the æcidiospores, sporula, chlamydospores, conidiospores, sporidia, teleutospores, ascospores, etc., of the mycologist. The word is to be taken only in its general sense. It will be seen however, that clear definition demands that the spore shall have some phylogenetic limitation as well as the ordinary morphological or physiological or embryological limitation. It thus happens that one is compelled to examine the course along which the higher types of spores have developed. It will then appear that the use of the word in different orders of plants is always with a group of reservations peculiar to the particular plant, or series of plants, in question.

The spore appears in its generalized form in such plants as the bacteria and among low algæ, such as the Protococci, the Chroococci or Palmellaceæ. Here it is a cell which must be defined by setting it over against the ordinary vegetative cell of its plant. In *Bacillus anthracis*, for example, the spore is but little different from the ordinary cell and may be limited very properly by considering it an ordinary cell in which such slight specializations as have appeared are directed towards the withstanding of temperature changes and other external influences that might be dangerous if not made the basis of an adjustment. Such spores as these may be considered as generalized and basal, and may for the purposes of this classification be known as *primospores*.

In the well known *Ulothrix*, and in plants above, but near its plane we find that the primospores become themselves a subject for further differentiation and they function either as spores or as gametes, in the lower plants of this division, while in the upper the specialization is perfected to heterogamy. In Ulothrix and its allies, then, the spore is not only to be set over in contradistinction to the ordinary vegetative cell but it is also limited from the imperfect reproductive cells,

the gametes, and thus acquires a new meaning. Spores of this type may be termed here *secundospores*.

In *Œdogonium* the sporophytic structures emerge. The well known facts of Œdogonium life history need not here be detailed. It will be remembered that the fertilized egg undergoes rejuvenescence and segments into usually four spores, motile and similar to the spores of the gametophytic generation which are themselves of the secundospore type. The spores thus formed as the result of sporophytic segmentation may be distinguished very well under the name of *tertiospores*. They are characteristic of the Œdogonium series and are more generalized than other sporophytic spore structures.

Passing to *Riccia* and its allies, we encounter the fourth type of spore, from the point of view of this classification. In Riccia the segmentation of the fertilized egg proceeds until a structure is developed that consists not only of spores but of enclosing, protective and more or less vegetative cells. In this case, the reverse process to that observed in the lower plants has taken place. Instead of spores emerging from the modification of vegetative cells one finds vegetative cells tracing back to spore cells. Indeed, therefore, the whole vegetative system of higher plants may be considered as developed from a series of reproductive cells as seen in Œdogonium, while in the series below the emergence of the sporophyte the spore cells must be considered as an emergence from that more generalized type of cell which is at once reproductive and vegetative. Such spore cells as those of Riccia, since they must be defined as developed with the by-cells of the segmentation, are to be held in contradistinction with the vegetative sporophytic structures. Such spores, following the terminology, may be known as *quartospores*.

While bisexuality of gametophytic plants may originate without a preliminary morphological differentiation of the spore, as for example in *Equisetum*, nevertheless it happens that the sex of the plant to be produced from the spore may be predetermined not only in the inner activities of the spore but in its size, shape and general structure. In this way heterospory appears and we discover in such excellently investigated plants as *Pilularia*, *Isoetes* or *Selaginella* among the so-called cryptogams and in *Taxus*, *Lilium* or *Narcissus* among the so-called phanerogams a predetermination of the sex of the plant to be produced, long before the spore that is to produce the plant is itself mature. In cases like this,

whether it be the pollen spore of the composite, the embryo-sac-spore of *Casuarina* or the less modified heterospore of *Marsilia* or *Azolla* or *Isoetes*, it becomes impossible to define the spore without attention to the sexual *potentiality* of the cell and the function of its plant-product that is to be the result of germination. Such spores as have undergone this profound morphological differentiation with regard to the sex of the plant to be produced from them may be given the name of *quintospores*.

It seems clear that in the great lines of development of the vegetable kingdom there are these five types of spores to be distinguished one from another. To each of them the term *spore* is ordinarily applied but, as I have attempted to show, with a widely different implication in each case. The word *spore*, then, in the Bacteriaceæ stands for a very different structure than does the same word in the Compositæ. It may be objected that this is but to transfer new ideas into the word and thus make it more difficult to comprehend. The objection is hardly well taken, I think, for it is evident that the analysis does not read anything into the word that has not already, by common consent, been included in its meaning.

Of the five phylogenetic types of spores, if I may name them so, the first two belong to the plants below the sporophytic emergence. It is remarkable that these types of spores, so fully represented low in the scale, are so completely lost as one passes higher. In Œdogonium both secundospores and tertiospores are formed, but in the gametophyte of the Muscineæ, only a short distance above, they seem to be wanting. The suggestion might be made that the propagative cells of the archegoniate gametophyte may be the representatives of the secundospores of Œdogonium. Gemmæ of *Marchantia* or *Tetraphis* might be thus homologized and would then either appear to be multiple spores like those of some of the fungi, as *Macrosporium* or *Cladosporium*, or would be the result of a development from an original spore-cell. In any case the view here indicated, that the persistence of the secundospore would be a fruitful study, may be productive of some results. Again, the notion that the vegetative cells of sporophytic structures may be traced back to tertiospores, gives some additional light, it may be, upon the high degree of vegetative propagation, so-called, that goes on in higher sporophytic structures. Vegetative development being the acquired state of the cell it would be possible to ex-

plain the propagative activity that often makes itself apparent even in highly specialized organs, as the leaf of the Begonia, by the laws of reversion, and vegetative propagation would become atavistic in its implication. Entirely apart, however, from speculations like these it seems well to insist upon the close examination of even so common a term as the word "spore," for any increase in exactness is an impetus to thought, that should not be underestimated.

University of Minnesota.

The range of variation in species of Erythronium.

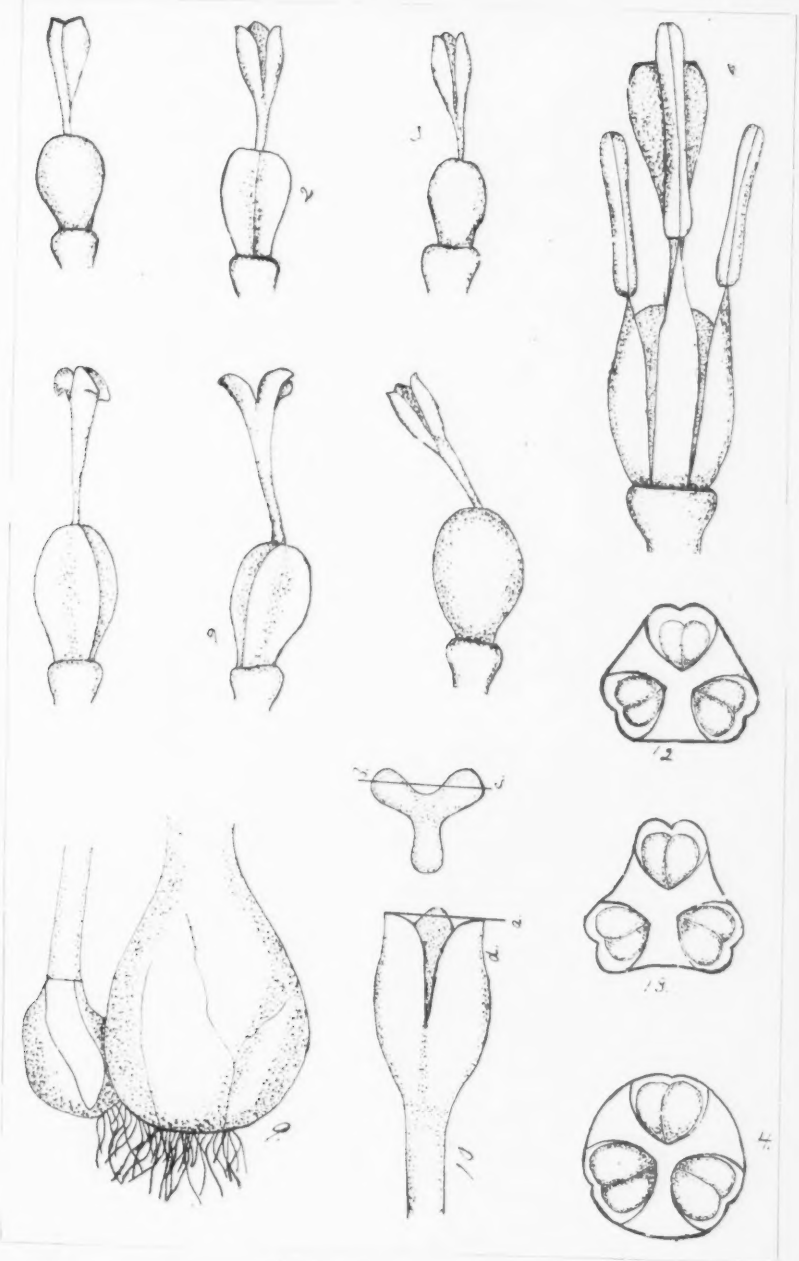
M. E. MEADS.

WITH PLATE XI.

About a year ago while working upon plant variations, some interesting variations of *Erythronium Americanum* were found of which I could find no record. During the past two years I have made a careful study of the two species, *E. Americanum* and *E. albidum*, with the view of ascertaining the limits of their variations. Over four hundred specimens have been examined, and the results seem to warrant publication.

According to the best authorities the principal specific differences of the two species lie in the stigmas and color of perianth; E. Americanum having an entire, club-shaped stigma, while the stigma of E. albidum is three-cleft and spreading. In the fifth plant of E. Americanum that I examined the stigmas were not united; they were 3.2^{mm} in length with a spread of 3^{mm}, and of fifty-three plants of which I took careful measurements, only seven had the stigmas united, the length of the stigmas ranging from 1.3^{mm} to 7.1^{mm}. As may be seen in figs. 1–3, the stigmas of E. Americanum are not recurved; fig. 10, on a much larger scale, shows this more clearly and also shows the contracted appearance, *d*, just below the apex; measurements for the spread of the stigma were taken above this at line *a;* these measurements range from 1.3^{mm} to 3.6^{mm}.

Owing to the curve of the stigma of E. albidum, it was impossible to take accurate measurements of the length; there is, however, a considerable range, although not as great as in E. Americanum. The spread of the stigma of this species,



MEADS on ERYTHRONIUM.

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figs. 5–7, in twenty plants from which I took measurements, varies from 1.1^{mm} to 4.6^{mm}. Fig. 11 represents diagrammatically the upper surface of a stigma, line *bc* showing where these measurements were taken. Sometimes the stigma has the contracted appearance of E. Americanum, fig. 7; in such cases the plant can only be identified by the color of the perianth.

A distinction has been made between the leaves of E. Americanum and E. albidum, regarding shape, size and markings. So far as my observations go, this is a distinction without a difference. I have found patches of E. Americanum where the leaves were entirely without blotches, and the leaves of E. albidum are frequently as deeply mottled as are ever found in E. Americanum. The shape in both species varies from broadly oval to nearly linear, and the size varies as greatly.

Another species, *E. mesochoreum*, has recently been claimed for Kansas. The noteworthy differences between E. albidum and E. mesochoreum, as given, are, briefly:

"*E. albidum* Nutt.— Leaves lance-elliptical, more or less mottled with purple or light green blotches; cross section of ovary blunt, triangular, with sides concave because of narrowed partitions; sterile forms propagated by paired underground runners which develop new corms at their extremities.

"*E. mesochoreum* Knerr.— Leaves much longer and more narrow, almost linear, never mottled; cross section of ovary bluntly triangular, with sides convex because of wider partitions; new corms developed at the base within the old; no runners."

In a dozen leaves of E. albidum of which I took measurements the length was from four to nineteen times greater than breadth; some of the leaves being nearly linear. According to Torrey the leaves of E. albidum are not marked. This spring I examined about a dozen plants of E. mesochoreum, kindly furnished me by Mr. Knerr. Among them was one plant, otherwise answering perfectly to the description of E. mesochoreum, with leaves deeply mottled with purple. Fig. 12 shows, on an enlarged scale, a cross section of an ovary of E. mesochoreum. It may not be a typical form, but answers the description the best of any in the material furnished me. While the sides of the ovary of E. albidum are usually concave, they are sometimes convex, figs. 13 and 14. I have examined about twenty corms of E. albidum,

and fig. 9 is a good type of what I have found in various stages of development in nearly all of them. This is also commonly found in E. Americanum. The following note from BOTANICAL GAZETTE, II (June, 1877) may throw further light on this species.

"The normal E. albidum from Illinois to western Iowa, noted for spotted broad leaves and very recurved petals, is confined to groves; while a much smaller form from western Iowa to Kansas confined to prairies has narrow leaves, never spotted, petals never recurved, not half the height of the former. The difference is doubtless due to soil and locality.—R. Burgess, Ames, Iowa."

The above seems to indicate that E. mesochoreum instead of being a true species is but a variety marked by certain variations constant in it, and found, but not constant, in E. albidum.

I took careful measurements of every part of the flower of E. Americanum and E. albidum, and plotted the curves according to the method used by Alfred Russell Wallace in animal variations. Comparing the results of thirty-four specimens of each, we find the length and width of the petal, length of stamens and ovary, and length and spread of stigma are closely correlated in E. Americanum. In E. albidum the variations of the length of the petals and ovary are more loosely correlated. The other parts vary independently, sometimes seeming to follow the variations of these, and again when a decided variation in some direction is looked for, varying not at all or even decidedly in the opposite direction. The general variations of the two plants are in an opposite direction, toward each other. This is shown by comparing the mean measurements of the different parts and the variations from that, in the following manner:

Length of	*Species.*	*Mean.*	*Number above the mean*	*Number below the mean*
Petal	Americanum	32.65^{mm}	19	15
Petal	albidum	34.45^{mm}	15	19
Style	Americanum	10.25^{mm}	23	11
Style	albidum	11.1^{mm}	11	21
Ovary	Americanum	10^{mm}	5	29
Ovary	albidum	8.25^{mm}	19	15

In all the plants of E. Americanum that I have examined I have found in the stamens a tendency to heteromorphism, fig. 8. In fifty-three plants from which I took measurements the mean difference was 2.65^{mm}, the greatest difference I have recorded is 4.5^{mm}, but I am convinced that some of which I was unable to get measurements had a greater difference even than this. Designating the longer set as *A* and the shorter as *B*, and comparing as above, we have:

Set.	*Mean.*	*Above mean.*	*Below mean.*
A	21.15^{mm}	27	26
B	18.5^{mm}	25	27

showing that the ratio of the two sets of stamens is nearly constant, with a very slight tendency to increased difference in length. This tendency to heteromorphism of stamens is also found in E. albidum, but is not so general, and as yet I have no measurements from them. In connection with this difference of length of stamens may be mentioned the fact that the pollen sacs of the shorter ones uniformly burst open before those of the longer; also the remarkably large number of cases found in which the pollen was not developed at all, the flower being pistillate with rudimentary stamens. In these individuals the anthers were yellow, while the fertile anthers are a dark brown or brownish red. Further study will be made upon these points.

Authorities seem agreed that the fertile form of Erythronium is two-leaved. I have frequently found three-leaved plants in both E. Americanum and E. albidum; the third leaf appears later than the other two, pushing up into view while the plant is in bloom.

My experiments in cross fertilization have not yet been carried out sufficiently to warrant any conclusions in this regard.

With us E. albidum grows in very rich, wet soil in the low, well shaded parts of beech woods; E. Americanum is found in the drier soil near, but grows more abundantly in the dry soil of the high, open parts, seeming to prefer clay to the rich leaf mould.

I wish to express my indebtedness to Prof. Hicks and Prof. Wheeler, of Michigan Agricultural College, for literature on this subject. Also to Prof. McFarland, of Olivet College,

for the interest he has taken and the assistance he has so kindly given in the work.

Biological Laboratory, Olivet College.

EXPLANATION OF PLATE XI.— Figs. 1–7, pistil of Erythronium Americanum; 5–7, pistil of E. albidum; 8, E. Americanum showing different length stamens; 9, corm of E. albidum; 10, stigma of E. Americanum, *a*, line of measurement, *d*, contracted part; 11, upper surface of stigma of E. albidum, *bc*, line of measurement; 12, cross-section of ovary of E. mesochoreum; 13, 14, cross-sections of ovary of E. albidum.

Noteworthy anatomical and physiological researches.

Anatomy of the tubers of Equisetum.

Leclerc du Sablon, describing the anatomy of these organs of *Equisetum*,[1] shows that they represent short branches reduced to a single internode. These tubers are situated upon the rhizome; they are able, when detached, to develop independent individuals. They are pear-shaped in *Equisetum Telmateja*, occurring in clusters of two or three at a node of the rhizome. A transverse section shows a very thin cuticle which has no incrustation of silica, and a starch-bearing parenchyma just inside the epidermis. This parenchyma entirely surrounds the central part of the tuber including the ring of fibro-vascular bundles. Each bundle is again surrounded by an endodermis, the radial walls of which show the spots named after Caspary. There is no lacune to be observed in the hadrome, which, in most cases is characteristic of the oldest part of the stem above ground in the *Equisetaceæ;* and the vessels are present in a still larger number in the tuber. These vessels are not arranged in any order, but scattered and intermixed with parenchymatic cells. The largest ones are not always situated in the outer part of the entire bundle, but are irregularly mixed with the smaller ones, and do not show the shape of a *V*, which characterizes the bundles of the stem. Towards the apex the bundles increase in number and unite to form a crown which corresponds to the terminal node of the tuber. Such anastomosing bundles are not known elsewhere in the internodes of the rhizomes of *Equisetaceæ*.

The most important character in the structure of these tubers, and by which they differ from the rhizome, are: The division of the endodermis into special endodermes, surround-

[1] Sur les tubercules des Equisétacées: Revue générale de Botanique, IV. (1892.) no. 39.

ing each bundle; the absence of lacunes in the hadrome; and the irregular arrangement of the vessels.

In contrast to *Equisetum Telmateja*, mentioned above, the tubers of *E. sylvaticum* are ovoid and arranged so as to form a rosary; but the structure agrees very well with that of the preceding species, except that some layers of the bark-parenchyma are strongly thickened so as to form a kind of protecting sheath around the central part of the tuber, which peculiarity is, also, to be observed in the rhizome of this species.—THEO. HOLM.

Yeast fungi.

Professor Emil Christian Hansen upholds[2] the correctness of statements concerning endogenous spore-formation in the cells of Saccharomyces, against the opposition of Moeller, to whose paper the February GAZETTE called attention. Hansen gives a short review of spore-formation in this division of fungi, the conclusion of which is that the spores possess a membrane and germinating power. Very likely Moeller has confounded oil-drops and similar formations often found in old cells, with the true spores. It is incomprehensible that anybody can doubt the formation of endogenous spores in Saccharomyces. But of course we have to follow strictly the rules given by Hansen [3]

Prof. Groenlund[4] has established four new yeast fungi, namely, *Saccharomyces Ilicis I* and *II* (both found on *Ilex*), *S. Aquifolii*, and *Torula Novæ-Carlsbergiæ*. The three Saccharomyces are found producing spores and the new species are based upon the relation of this phenomenon to temperature. The Torula gives beer a very unpleasant and bitter taste.—J. CHRISTIAN BAY.

Soluble pentoses in plants.

De Chalmot[5] gives in his studies on the pentoses in the plants a very important contribution to the chemistry of assimilation. The so-called "pentosanes" of Tollens[6] are widely distributed in the plants. These give pentoses by hydrolysis, and two sugars, arabinose and xylose, have been

[2]Centralbl. f. Bakteriol. und Parasitenkunde, XIII, (1893) 16.
[3]Meddelelser fra Carlsberg Laboratoriet, II, (1886) 152–167; III, (1891) 53–78.
[4]Zeitschr. f. d. gesammte Brauwesen, no. 30–32, 1892.
[5]Reprint from the American Chemical Journal, XV, no. 1. (1893.)
[6]Die landwirtschaftlichen Versuchsstationen, XXXIX, 401 (1891), esp. pp. 425—430.

obtained from them. The theory of assimilation, given by Baeyer, which assumes that formic aldehyde, being the first product of assimilation, is the origin of the carbohydrates, has been supported by the fact established by Bokorny[7], that sodium-oxymethylsulphonic acid could supply the amount of carbon wanted by Spirogyra.

All the natural pentoses so far known belong to the *l*-series, and all the natural hexoses to the *d*-series. Plants by assimilation either form hexoses and pentoses, or have the power to change *d*- into *l*-compounds. The theory of Baeyer, does not make it improbable that both pentoses and hexoses are formed. This work was undertaken to determine the limits of the reactions. Soluble pentoses which could be identified as wandering substances were sought.

It was possible in all cases which were examined to show the presence of soluble substances which form furfurol; but these substances might be hexoses which furnish traces of furfurol. On this account it was necessary to estimate how much furfurol the hexoses which were present could form and how much in fact was formed.

For the estimation of small amounts of furfurol a method was devised which depended on the color reaction of furfurol and an acetic acid solution of aniline. It was proved that the amount of hexoses present was not sufficient to explain the formation of all the furfurol and therefore soluble pentoses were present. Leaves and colorless bark were used for the experiments. The soluble pentoses are easily diffusible through membranes. The fact leads to the conclusion that the soluble pentoses are simple sugars, $C_5 H_{10} O_5$. The investigation confirmed the belief that the small amount of soluble pentoses is not perceptibly diminished by the death of the leaves. In the leaves of the oak there was found in the evening a small but evident excess in the amount of soluble pentoses over that found in the morning. Joined to this is the hypothesis that the soluble pentoses are temporarily converted into stable forms directly after their formation by the process of assimilation.

This paper forms a very important appendix to the long and fundamental paper by Tollens and his students from 1891 cited above. De Chalmot promises a further discussion of his hypothesis.—J. CHRISTIAN BAY.

[7] Biologisches Centralblatt, XXII, September, (1892.)

BRIEFER ARTICLES.

Description of a new fossil species of Chara.—In a former volume of this journal[1] I described, under the name of *Chara compressa*, a Chara fruit from the Wasatch group or lower Tertiary rocks of Wales, Utah. That species was well characterized by being longitudinally much depressed, the height being at least one fifth less than the width. The apex was obtuse or even slightly depressed and the number of spirals, as observed in side view, ten. This was the first North American species founded upon the 'fruits,' and I am now able to add a second equally well characterized species.

Chara Stantoni, n. sp. (Fig. 1, 2, 3.).—Fruit (sporostegium) oblong-elliptical in general outline, slightly smaller at apex, obtuse, nearly one fifth longer than wide (0.63^{mm} long, 0.48^{mm} in diameter); number of spirals as observed in side view eight or nine; cells furrowed, separated by thin, low projecting ridges.

This species was obtained by Mr. T. W. Stanton of the United States Geological Survey, for whom I take pleasure in naming it, from the west side of Smith's Fork of the Bear River, about 20 miles north of Cookville, Wyoming, in a locality that is of great geological interest. The horizon is the Bear River formation, which was long known as the Bear River Laramie, but which Mr. Stanton has shown[2] to belong to the lower part of the upper Cretaceous. The 'fruits' are scattered in considerable numbers throughout certain layers of the section, in a matrix of hard fine-grained bluish shaly limestone. They are associated with large numbers of fresh-water shells, among them *Pyrgulifera humerosa* Meek, *Corbula pyriformis* Meek, *Unio vetustus* Meek, *Limnæa nitidula* Meek, *L. haldemani* White and *Neritina naticiformis* White. The 'fruits' and shells are all perfectly silicified and were liberated from the matrix by disolving the limestone in acid.

CHARA STANTONI, n. sp.

This is one of the smallest fossil species known. As stated in the diagnosis, the sporostegia average 0.63^{mm} by 0.48^{mm}. The longest specimen measured was 0.70^{mm}and the shortest 0.60^{mm}. The largest diameter observed was 0.51^{mm} and the smallest 0.45^{mm}. In several instances specimens were found that had been fractured in the middle,

[1] XIII (1888). 156, 157, figs 1, 2.

[2] The Stratigraphic Position of the Bear River Formation. Am. Journ. Sci. XLIII, 98–115. Feb. 1892.

thus presenting a perfect cross-section (fig. 3). The central portion, corresponding to the oöspore was filled with nearly white silica, while the portion that was originally the wall of cellulose surrounding the oöspore was bluish in color. The furrows on the fruit (see fig. 1), caused by the five enveloping cells of the sporostegium, are separated by rather prominent ridges, but the walls are not marked with dots or processes as is so frequently the case. The base (fig. 2) showing the origin of the five enveloping cells, presents a small five sided orifice which answers to the point of attachment.

Among the 60 or more species that have been described in a fossil state, there are several that resemble *Chara Stantoni* in general appearance, but when more closely examined it is found that they all differ in size or number of cells exposed in side view, and as these are characters of great constancy it serves clearly to distinguish them. The geological position of this species prove it to be one of the oldest yet described. So far as now known the genus Chara had its origin in the Triassic, where it is represented by a single species. The Jurassic has two species, the Cretaceous very few, while the most are found in the upper Tertiary. — F. H. KNOWLTON, *U. S. National Museum, Washington, D. C.*

Is Cypripedium spectabile poisonous to the touch?—In the *Torrey Bulletin*, VI, 15 it is stated on the authority of the late Prof. H. H. Babcock of Chicago that after handling *Cypripedium spectabile* or *C. pubescens* he found himself suffering from a severe attack of skin poison. He had taken great pains to keep clear of *Rhus toxicodendron*, but notwithstanding, the same symptons continued several successive seasons at a time when he was accustomed to handle the Cypripedium. The possibility of any effect of this kind was discredited at the time (*Torr. Bull.* VI, 22) nor did it seem credible. Some years later a similar case occurred in this vicinity and was reported to me by the attending physician. A lady near whose home grew a fine clump of Cypripedium spectabile had been in the habit of gathering it when in bloom and using it sometimes for home decoration and sometimes for the decoration of the church. At such times for four or five successive seasons she suffered from syptoms of Rhus poisoning, but on careful examination no Rhus could be found where the Cypripedium grew. These symptoms invariably appeared whenever the Cypripedium was in the house and disappeared with its removal, and on her removal to another part of the country never re-appeared. In fact, when she ceased collecting the plant she escaped entirely.

A third instance of a similar kind occurred in this part of the country in connection with one of my own students who had always been in the habit of handling Rhus with impunity and had done so for years.

Not long since he was severely poisoned immediately after having gathered and handled a large quantity of Cypripedium spectabile and in view of the above facts very naturally attributes his trouble to this plant.

The above is largely circumstantial evidence, it is true, but any one who has examined Dr. James C. White's *Dermatitis Venenata* cannot but suspect that there are not a few plants, harmless in the case of the great majority of those who handle them, which nevertheless may be harmful to certain persons of peculiar temperaments and susceptibilities.—HENRY G. JESUP, *Hanover, N. H.*

The pine grosbeak's attack on the ashes and spruces of Cambridge, Mass., in January, 1893.—For several days preceding January 15th, Cambridge received a visit from an unprecedented number of pine grosbeaks from the north. Flocks of hundreds filled the trees and grounds here and there throughout the city. Mr. William Brewster, the ornithologist, says that it is not at all strange to see a few of these birds during the winter, and that about every third year, they are apt to visit this region in considerable numbers, owing probably to a scarcity of food in their native home.

What they fed on chiefly, during their last visit, was the seeds of the ash and the buds of the spruces. They would attack a large ash tree, laden with fruit, and in a few hours strip off every key. Their method was to take the key in the beak, deftly split open the outer covering of the base of the fruit, and extract the seed. This Mr. Brewster saw them doing by hundreds, as he stood close by under the trees. The birds were so tame, in fact, that one could stand close up to them, within reaching distance, but they would hop away quickly, if an attempt was made to catch them. I was unfortunate myself, in not seeing the birds shelling the ash keys, but I did see the snow under the trees literally covered by the fallen fruit, and my herbarium contains a pocket full of the remnants left by the birds. As a rule, the key was entire, with the exception of the slit in the ovary, the slit running quite through both sides. Generally the wing was untouched, but sometimes it was split clean through. This divided the key into two parts, but I think the action was not at all intentional on the part of the bird, his object naturally being merely to get the seed.

The birds almost completely stripped the spruces of their buds, and I am much interested to know what effect this treatment will have on the growth of the trees. The Norway spruce is our common species, and though, as in the case of the ashes, I did not see the birds at work, I saw and made a careful examination of the havoc which they committed. Here again I have Mr. Brewster's testimony to the wonderful sight afforded by these voracious birds. The spruces were laden with

snow which had recently fallen, and, as the birds plied, on every branch, their unwearied task, a thin veil of snow was continually shaken to the ground, and through it the bright colored beams of the newly risen sun cast a rosy light. The buds, terminal and axillary, of the Norway spruce, are small, and the birds left on the tree the scales of the lower half, extracting the rest to the very base of the bud. The reason for this would appear to be, that there is a natural point of division, half way between the base and the end of the bud, the scales on the lower half being, apparently. tougher and more firmly attached to the stem. The natural instinct and experience of the bird would teach him to attack the bud at the weakest point. From the base of the bud thus extracted, the bird would quickly pick out the small nucleus of tender tissue, the germ of the next year's growth of stem or inflorescence. This growing point I found to be just the size of the head of an ordinary pin, so that it is no wonder that the poor hungry grosbeak was not to be satisfied in a short time.

The bird, having picked out this nucleus, would throw the remnant to the ground, and the snowy carpet beneath the trees was thickly covered with bud scales, which were lying either separately or in the shape of the little bud as it was picked from the tree. A small hole under the bud showed where the vegetative cone had once been. I carefully examined portions of one large spruce, and I was unable to find a single bud intact. I have heard that a judicious pruning of the buds of a tree by the feathered tribe gives new vigor to the tree, but what will be the effect of this wholesale slaughter? I shall watch the trees with interest this spring, when the buds should begin to unfold.

The grosbeaks were here but a few days. As soon as they had exhausted the food supply, they departed for new fields. It is to be hoped that they have already satisfied their boundless appetites, and given the remaining spruces, at least, a chance to awake in the spring from their winter's nap.—WALTER DEANE, *Cambridge, Mass.*, Jan. 22, 1893.

EDITORIAL.

ATTENTION should be called to the work of the standing committee of the American Association on Biological Nomenclature. This Committee is the American representative of a proposed International Committee, having been appointed in response to a request from the Australasian Association. The movement promises to be as extensive as the original intention, and the American Committee, composed of

Goodale, Coulter, Gill, Minot, and Gage, have gone seriously to work to prepare their contribution to the work of the International Committee, the larger share of which, it is but just to say, has fallen upon Professor Gage. In these days, when investigation is being multiplied so enormously, and new terms are being constantly coined, a uniform system of nomenclature in morphology is becoming no less desirable than in systematic work. The committee has formulated certain underlying principles to guide in the selection of a biological terminology, and it is the desire of the GAZETTE to call the attention of American botanists to these principles. The first is that the names of organs and parts, and terms indicating position and direction, should be single designatory words so far as possible, rather than descriptive phrases. The necessity for this becomes more apparent in zoological anatomy, where the names of men are often applied to anatomical structures, than in botanical, where the tendency is to follow this rule, though there are notable exceptions. Another principle, which would have a good deal to do with botanical terminology, suggests that morphological terms should be etymologically correct, and so far as possible derived from Greek or Latin, and that each term should have a Latin form. Such phrases as " antipodal-cells," "sieve-tubes," etc., etc., would disappear under both of these principles. Another important principle recommends that each of the technical words have, in addition to its proper Latin form, a form which shall make it conform to the genius of the various languages, that is, that a paronym be made for each technical word. This is really a very important suggestion, and the word would be so slightly changed that one familiar with its classical form would recognize it instantly in either Italian, French, German, or English. There can be no doubt that if this principle of paronyms was adhered to the intelligibility of scientific writing would be greatly increased. The word "Biology" itself is an excellent example of what is meant. Whether "Biologia," "La Biologia," "La Biologie," "Die Biologie," or "Biology," it is always recognizable.

The Committee also urgently recommend that whenever a technical word is used for the first time, the author should give, in a special note, the Latin form, the etymology, the proper paronym for his own language, and as concise and precise a definition of the term as possible. This is surely a reasonable price to pay for the introduction of a new term. This exactness of definition should be as much demanded as the exact description of a new species.

It is also a very desirable thing to unify botanical and zoological morphology so far as possible. The subject is a very difficult one, and such a movement would necessarily be slow, but it was begun when the name protoplasm was adopted for the same substance in both

plants and animals. All this involves the preparation by the International Committee of an authoritative glossary of biological terms, and the keeping of a systematic record of new terms. Like many other movements toward desired uniformity, its first result will probably be seen in the adoption by individual biologists of a conscious and systematic plan of terminology. It will not be very troublesome to unify future action; but the serious conflict will come when there is a demand to make to conform to new rules whatever of ancient terminology conflicts with them. However, American botanists should encourage this movement in every way, and it would be well to consider the subject at their next general meeting.

CURRENT LITERATURE.

The flora of Minnesota.

Minnesota has provided so liberally for its geological and natural history survey that the scientific men of other states might well feel envious. The first report[1] of the present state botanist has now been distributed and the size of the volume and excellent typography speak well for the wealth of material and opportunity for its creditable presentation. It is surprising how much can be said concerning a comparatively limited flora when one industriously studies it and begins to look at it from many points of view. Professor MacMillan has set a very high mark for state catalogues, and one that it is probably not necessary to reach in many cases. The introduction to the volume was previously distributed and noticed in this journal. In a preface the author agrees to follow the Rochester agreement and indicates the changes it would make in the nomenclature of the catalogue, the body of which was beyond his control at the time of the Rochester meeting. Although not in harmony with all the details of that agreement, the author frankly accepts them in the interest of uniformity, and if this spirit is universal American systematic botany has been emancipated from the fetish of names and can begin to study plants.

The list begins with the lower Metaspermæ and ends with the Compositæ. The Polypetalæ and Apetalæ are merged, as they ought to be, under the name Archichlamydeæ. Naturally this merging is very

[1] MacMillan, Conway.—The Metaspermæ of the Minnesota Valley. A list of the higher seed-producing plants indigenous to the drainage-basin of the Minnesota River. Reports of the Geological and Natural History Survey of Minnesota, Botanical series, I. pp. xiii. 826, with two maps.

tentative as our knowledge of the phylogeny of these groups lies chiefly in the future, but it is just as well to express the little knowledge we have. The details of the list are carefully worked out as follows: name of family, with authors, synonyms and dates: number of genera and their general distribution; approximate number of species; name of genus, with author, place and date of publication; synonyms and dates; number and distribution of living species; number of extinct species if any have been recorded; name of species, with full synonymy, dates, etc.; North American and local distribution; representation in Minnesota collections. It will be seen that this gives a very large amount of information concerning the bibliography and range of each plant and will be of very great service to botanists. The list is summarised as follows: families, 106; genera, 407; species and varieties, 1174.

In our limited space it will be impossible to fully notice the general discussion of the metaspermic flora of the Minnesota Valley as contained in the last 200 pages. All the features of the valley which have to do with plant-life are first discussed, and this is followed by a very full consideration of the problems of geographical distribution in general and the local forces in particular which have had to do with the origin of the Minnesota flora. Numerous tables of statistics are given, and a full index closes the volume. Professor MacMillan is to be congratulated upon this very full and complete presentation of the subject he has had in hand. It must have involved an immense amount of careful and confining work, but we are confident that his labor has not been in vain.

Minor Notices.

THE SECONDARY EFFECTS OF POLLINATION have been presented in an able paper by W. M. Munson,[1] who has critically collated a very large number of published observations on the subject, chiefly from English and American sources. His own extended researches make his opinion especially valuable. Among the conclusions at which he arrives the following are especially prominent: Within certain restricted limits there is an immediate influence of pollen on the mother plant; the pea, kidney bean and Indian corn show unmistakable evidence of immediate effect of foreign pollen, while curcurbitaceous and solanaceous plants exhibit no immediate effect; the form and size of tomato plants are directly dependent upon the amount of pollen furnished; the egg-plant and English forcing cucumber are the best examples of organic development of fruit.

[1] Annual Report of Maine Agricultural Experiment Station, 1892, part II. pp. 29-58. Illustrated. Issued under separate cover.

DR. WILLIAM TRELEASE, although fully occupied by the cares of the directorship of the Missouri Botanical Garden, finds time to publish periodically, and the periods are getting shorter, pieces of work that serve well to continue the reputation that Dr. Englemann brought to St. Louis. We have before us his further studies[1] upon that fascinating subject, the pollination of Yuccas. Dr. Trelease has had further opportunity of studying Yuccas in the field and has added a large amount of valuable information concerning this interesting group. Three species of Pronuba are now known to act as pollinators, and it is predicted that others will be found. After giving detailed notes of the various species, the author gives an interesting discussion as to the probable former range of Yucca and its adaptation to Pronuba pollination. It seems to be fairly well made out that the genus was formerly of much wider and more northern range, has been driven southward, and is now preserved in favoring localities. It also seems more than probable that ancestral forms had separate spreading stigmatic lobes, which by their union have formed "the peculiar stigmatic chamber into which the pollen must be thrust in order to properly develop its tubes and fertilize the ovules." The separation of these stigmatic lobes has been observed both in Hesperoyucca and the true Yuccas. It is naturally to be supposed that the evolution of Pronuba has gone "hand in hand with the adaptation of the Yuccas to their services in pollination," an evolution which Professor Riley has broadly sketched. A very interesting biological fact is, that a variety of Y. Whipplei (*y. graminifolia* Wood) has as its pollinator a black variety (described here as new) of the Spotted Pronuba which pollinates the species. Another suggestive fact is that Pronuba yuccasella accompanies the true Yuccas across the continent, and in California pollinates Y. baccata, and at the same time is associated with three other forms which are pollinators of Pacific types. Twenty-three excellent plates illustrate the paper, showing various species of Yucca, and Pronuba with dissections.

MR. CHARLES ROBERTSON, whose studies on the relation of flowers and insects are well known to the readers of the BOTANICAL GAZETTE, has just distributed the results of his studies among the Labiatæ.[2] The group is one of special interest in this connection, and after presenting details of observations Mr. Robertson discusses the family as to its flower forms, pointing out the least and most specialized ones and their probable origin. The unremitting attention which Mr. Robertson has given to this work has brought together a vast body of facts, which will presently represent all of our entomophilous groups.

[1] TRELEASE, WILLIAM.—Further studies of Yuccas and their pollination. From 4th annual report of Mo. Bot. Garden. pp. 181-226, plates 23.

[2] ROBERTSON, CHARLES.—Flowers and Insects—Labiatæ. Trans. St. Louis Acad. Sci. VI. 101-131.

Mr. Henry Willey has long been identified with the critical study of North American lichens, and since the death of Professor Tuckerman has been our lichenologist of largest experience. He has issued a pamphlet,[1] which he says terminates his thirty years' labor on the New Bedford lichens. Of the 369 species enumerated thirty-nine were new when first discovered, the present paper containing four not previously defined. The author expresses his regret "that the American professors of botany have so generally accepted the 'Schwendener theory,' as it is called, that lichens have no independent existence, but consist only of a fungus associated with an alga; and this, too, simply as a dogma, without having acquainted themselves with the arguments against it by the prominent lichenographers of Europe, and by Professor Tuckerman, in this country, and without having made any special studies of the plants themselves. These arguments constitute a considerable body of literature, of which none of these professors seem to have more than a little if any knowledge." A retort to this would be easy; but Mr. Willey can rest assured that whether lichens are to preserve their autonomy or are to be considered as wonderful examples of symbiosis they will always excite much interest and long be in need of critical study.

Botanists who were present at the Washington meeting of the American Association, will remember Professor J. M. MacFarlane's public address upon plant hybrids. The full paper,[2] of which the address was simply a brief popular account, has now been distributed. The author has recorded fully his investigation of nine hybrids and their parents. He has, in every case, compared the three individuals as to external characters and internal structure, and has discovered that in every particular the hybrid has an intermediate character. The results he gives as to abundance and kinds of plant hairs, the distribution of stomata, the nature of the various tissues, even the structure of starch-grains and other cell-contents, show a remarkable intermingling of the characters of both parents. The bearing of these facts upon current biological problems is discussed, but from our point of view the facts presented tend more to substantiate such views as those of Weismann and his school than to discredit them.

Professor A. S. Hitchcock has just distributed the report of his

[1] Willey, Henry.— Enumeration of the Lichens found in New Bedford, Mass., and its vicinity, from 1862 to 1892. 8vo. 40 pp. Printed for the author, New Bedford, 1892. 50 cents.

[2] MacFarlane, J. Muirhead.—A comparison of the minute structure of plant hybrids with that of their parents, and its bearing on biological problems. Reprinted from Transactions of the Royal Society of Edinburgh xxxvii. pt. 1. no. 14. pp. 203–286. pls. 8.

expedition to the West Indies[1] during the winter of 1890-91. It consists of a list of the plants collected, together with a discussion of the Bahama flora, in which it seems evident that it is of southern origin. The few pages of the preface are chiefly devoted to discussing matters of nomenclature. In this the author was particularly fortunate in the delay of publication so that he is able to present a list which conforms to the Rochester agreement. Knowing something of the difficulties of collecting in the West Indies, and of determining the material when collected, the writer must congratulate Professor Hitchcock upon the length of the list and the very careful way in which it is presented. Every genus and species bears its date, a thing which will presently be as necessary as the author.

MR. W. W. ROWLEE has distributed a paper (with five plates), reprinted from January number of the *Bulletin* of the Torrey Botanical Club, on akenes and seedlings of Compositæ. He has studied various facts of structure and phenomena of germination. Very naturally, this detailed study of structure has shown that some of our generalizations have been too sweeping. His study of seedlings is compactly and clearly put, and is a valuable addition to the mass of similar facts being collected.

PROFESSOR ALBERT A. WRIGHT, of Oberlin, has issued a supplement to his list of the "Flowering and Fern Plants" of Lorain county, Ohio, (published in 1889). The list hereafter is to be referred to as Laboratory Bulletin no. 1. Over 100 new members have been added, making the total enumeration of species 931.

THE THIRTY-FIRST "Contribution from the herbarium of Columbia College"[2] deals with the genus *Polygonum*. Mr. Small recognizes seventy-nine American species and gives their range and synonymy. Two new Mexican species of PERSICARIA are described and some manuscript names and *nomina nuda* defined.

"THE OPENING of the buds of some woody plants" is the title of a recent paper[3] by Professor Hitchcock. It is a series of notes taken during the spring of 1892. The field is a new and good one, and the study of twigs or winter-condition of shrubs and trees will presently have a literature of its own.

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[1] HITCHCOCK, A. S.—Plants of the Bahamas, Jamaica and Grand Cayman. From 4th Annual Rep. of Mo. Bot. Garden. Issued March 9, 1893. pp. 47–180, with 4 plates.

[2] SMALL, JOHN K.—A preliminary list of American species of Polygonum. Reprinted from Bull. Torr. Bot. Club XIX, 351–370.

[3] HITCHCOCK, A. S.—The opening of the buds of some woody plants. Trans. St. Louis Acad. Sci. VI. 133-141. 4 plates.

OPEN LETTERS.

That "probably carnivorous" Polyporus.

I am much obliged to Mr. Cook for his helpful criticism in the March GAZETTE of my note in the November number. The points that he makes strike me as generally well taken and it was because of my recognition of their force that I entitled my note a "*probable* new category of carnivorous plants." I intended to make plain to all readers that my interpretation of the facts was a purely tentative one. I am not yet sure, however, that *Polyporus applanatus* does not digest the unfortunate flies. I distinctly stated that the production of new pores was *not* while the fly was in "high relief" upon the surface, but after the fly was *thoroughly digested.* In this case the "surface area" was not larger than before though the pores were more numerous and somewhat smaller than upon a similar area where no fly had been captured. Thus Mr. Cook's objection, and his principal objection, seems to be scarcely to the point. To be sure I speak of the flies "raising the hymenial level," but since this is a tabular not a rounded excrescence there is really no increase in poriferous surface. The statement was, however, not sufficiently clear and I readily see how it led Mr. Cook astray. I take pleasure in amending it. And again, it occurs to me that the illustration given by Mr. Cook of the way in which the Polyporus hymenophores "grow around" small twigs, etc., is hardly applicable to this case. It is not the general growth that encloses the fly but a renewed putting forth of hyphæ from the interior of the pores, apparently under the stimulation of the fly's presence. This struck me at the time and still appears to me to be noteworthy.

The little flies that I examined really did "lie flat upon the surface of the hymenophore." Perhaps this was due to prolonged tetanic contractions of the interesting muscles in their legs. But I leave that to Mr. Cook.—CONWAY MACMILLAN, *University of Minnesota.*

NOTES AND NEWS.

MR. J. G. BAKER is publishing in the *Gardeners' Chronicle* a synopsis of the species of *Canna.*

MR. A. A. HELLER has published a preliminary list of the lichens of Lancaster county, Penn.

A SPECIMEN of Cereus senilis ("old man cactus") which has been in cultivation in England for about sixty years has grown only about three inches in all that period.

THE PROTECTION of plants against snails has been studied by L. Piccioli, who finds that such substances as tannic acid, latex, essential oils, raphides, etc., furnish the chief protection.

DURING THE coming season Mr. Charles W. Armstrong, of Toronto, intends to go thoroughly into the flora of York county, Canada. He will collect sets of plants for specialists in any group above bryophytes.

THE AMERICAN literature of compass plants is cited and commented upon in the January number of the *Deutsche botanische Monatsschrift* by J. Christian Bay of the Missouri Botanic Garden. Seventeen articles are mentioned.

MR. F. L. SARGENT advocates in *The Household* the claims of the Columbine to be the national flower. He finds in it the Phrygian liberty cap, the five-pointed star, the cornucopia, the thirteen original states, and the red-white-and-blue!

A NEW FORM of plant press is figured and described in Queen's *Microscopical Bulletin* for February. It is made of wood, held together with straps, and has elastic bands to keep the unused papers in place. It weighs but 22 ounces without papers, and will doubtless prove a popular press for field work.

DR. KARL PRANTL, professor of botany and director of the botanic garden of the University of Breslau, died in that city on the 24th of February. Dr. Prantl is also well known as an author of many valuable works; as the editor of *Hedwigia*; and as the joint editor, with Engler, of *Die natürlichen Pflanzenfamilien.*

IN *Proc. Philad. Acad.* for 1892 (pp. 357-365) is the beginning of another botanical series by Professor E. L. Greene, under the title "Eclogae Botanicae." Under the name of *Carduus* a number of new western thistles are described, and the old ones transferred. Three new lupines are also described, one from Colorado, the other two from California.

NOLL DESCRIBES[1] two lecture experiments, one showing the visual influence of the coloring matter of Florideæ; another showing a heliotropic experiment with the sporangia of Pilobolus crystallinus placed in the Sachs heliotropic camera[2] or a modification of this instrument. Both of the experiments are suited to catch the student's attention.—BAY.

THE QUESTION of the root-tubercles of Leguminosae bids fair to become still more complicated. B. Frank and H. Moeller are engaged in a discussion concerning an announcement by the former that Pisum sativum has two kinds of tubercles, differing in position, size and content; a thing which the latter claims is simply due to difference in age.

OBSERVATIONS on root tubercles upon both indigenous and introduced plants of the northwest, made by Prof. H. L. Bolley (Agricultural Science, VII, 58) indicates that such tubercles are common upon all native species of the order, as well as upon introduced species. But the latter were often without tubercles when growing upon virgin soil, especially when not more than one season old.

MR. THOMAS HOWELL, in *Erythea* (Feb.), has suggested a rearrangement of American *Portulaceæ*. It has chiefly to do with the delimitation of Claytonia, Montia, and Calandrinia. A new genus, *Oreobroma*, is proposed, "named in allusion to the edible fleshy roots," and contain-

[1] Flora LXXVII, pp. 27-37.

[2] Vorlesungen, 1887, p. 737.

ing species taken out of Calandrinia, Lewisia, and Claytonia, to the number of ten. Professor Greene had already previously transferred species of other Claytonia to Montia.

WHILE DETMER (on the nature and importance of the physiological units in the plant)[1] is broadening out the plasome-theory of Wiesner, assuming that the life is closely connected with the "living albumen-molecule"[2], we find Crato[3] adding a contribution to the theory of Bütschli, assuming the applicability of the comb structure in the protoplasm. Detmer's paper is a very valuable contribution to the physiological theory of cell-structure.—BAY.

PROFESSOR J. VON SACHS has finished the publication of his collected works on vegetable physiology, which collection, however, does not comprise all of his papers, but only the most important of his many contributions. The two stout volumes will, of course, be one of the things that the botanical student has to read. Notes under the text show the renowned investigator's altered views on many subjects, many of these notes being very illustrative. The plates accompanying many of the papers have been replaced by figures in the text.—BAY.

A NEW anthracnose of privet (Ligustrum vulgare) is described and figured by Geo. F. Atkinson in a recent bulletin of the Cornell station (No. 49). It attacks the twigs forming brown, depressed spots, which sooner or later extend around the stem and cut off the supply of sap to the portion above, thus killing the twig. Pure cultures on nutrient agar-agar were studied. The fungus proves to be a new species, and is described under the name of Gloeosporium cingulatum, being closely related to G. fructigenum, which causes the ripe rot of apples.

THE International Standing Committee on nomenclature, appointed at the Genoa congress is as follows: *Germany*, Ascherson, Engler, Radlkofer; *France*, Baillon, Bureau, Malinvaud; *England*, Baker, Clarke, Hooker; *Russia*, Batalin, Schmalhausen; *Switzerland*, De-Candolle; *Italy*, Caruel, Saccardo; *Austria*, Celakovsky, Kanitz, Kerner, Willkomm; *Belgium*, Crépin, Durand; *Sweden*, Fries, Wittrock; *Portugal*, Henriques; *Spain*, Lara; *Denmark*, Lange; *Netherlands*, Suringar; *Australia*, Von Mueller; *United States*, Britton, Coulter, Greene.

BY TREATING SPECIMENS of Spirogyra from which the starch had been entirely removed with substances which readily break up into simpler constituents, of which formic aldehyde is one, Herr T. Bokorny showed that these plants have the power of separating formic aldehyde from the nutrient solution, and then converting it into starch. This appears to furnish argument in favor of the view that formic aldehyde is the substance first formed in the production of carbohydrates from the carbon dioxide of the atmosphere.—*Jour. Roy. Micr. Soc.*, Feb.

NUMBERS 76—79 of Engler and Prantl's *Die natürlichen Pflanzenfamilien* have just been distributed. No. 76 contains a continuation of the

[1] Berichte d. deutschen bot. Gesellschaft, x, 441 (1893).
[2] See Pflüger, in his Archiv f. d. ges. Physiologie, x.
[3] Berichte d. deutschen bot. Gesells. x. 451.

first volume, and presents Myxogasteres, Fungi, and Chytridineae, by J. Schröter. No. 77 contains another installment of the Leguminosae, by P. Taubert; No. 78 contains the Cyrillaceae, by E. Gilg, the Aquifoliaceae, by M. Kronfeld, and the Celastraceae, by Th. Lösener; No. 79 contains the Chenopodiaceae, by G. Volkens. In all these parts the same splendid typography and engraving continues. The American genera of the groups above mentioned stand very much as our monographers have left them.

By a series of experiments extending at intervals over three years made with the intermittent klinostat (a klinostat so modified as to make a partial rotation at regular intervals, remaining stationary in the mean time) Professor Francis Darwin and Miss Pertz have shown that rhythmic curvatures in plants may be artificially induced by exposing shoots to alternate and opposite stimuli of a geotropic or heliotropic nature. When a plant had come to be in a thoroughly rhythmic state they found it possible to prophesy to a minnte at what time the reversal of curvature would take place. These experiments are of great interest in their bearing on periodic movements.

Dr. Karl Gœbel calls attention in *Annals of Botany*, vi. 355, and also in *Flora*, to the location of the sexual organs in Buxbaumia, in which the single antheridium is borne on the protonema itself, with only the formation of a single involucral leaf, so that alone this structure would pass for an alga; while the archegonia are borne on a very rudimentary stem with several involucral leaves. Thus Buxbaumia comes very near to the theoretical idea of the simplest moss, which looks upon the protonema as the primitive oophyte, and conceives the leafy stem to be a specialized archegoniophore which gradually came into prominence as an advantageous host of the sporophyte.

M. Ph. van Tieghem, in *Journal de Botanique* (March 1) discusses the classification of Basidiomycetes. He recognizes nine co-ordinate families in the group, as follows: Lycoperdaceae, Agaricaceae, Tilletieae, Tremelleae, Tylostomeae, Ecchyneae, Auricularieae, Pucciniaceae, and Ustilageae. The first family contains five tribes, the second nine, the eighth ten, and all the rest are represented by a single tribe. The Lycoperdaceae contain Gastromycetes of authors, excepting Tylostomeae and Ecchyneae, which are raised to family rank. The Agaricaceae contain the Hymenomycetes of authors, and also the Dacryomycetes usually included under the Tremelleae.

Mr. Thomas Morong has some interesting notes on Orchids in the *Bulletin of the Torrey Botanical Club* (February). A new species of Listera from Hudson Bay Territory is described; attention is called to the fact that many orchids are capable of self-fertilization; and certain necessary changes in nomenclature are pointed out. According to our recent agreement in reference to date, *Calopogon* R. Br. should be replaced by *Cathea* Salisb.; *Spiranthes* Richard by *Gyrostachys* Persoon; *Goodyera* R. Br. by *Peramium* Salisb.; and *Mycrostylis* Nutt. by *Achroanthes* Raf. In a note in the March number, however, he corrects his change of Colopogon to Cathea and says that *Limodorum* is entitled to use.

AMONG RECENT bulletins from the Experiment Stations containing botanical matters are the following: "Oat smut" by L. R. Jones (Vt., No. 6); "Can peach rot be controlled by spraying?" by F. D. Chester (Del., No. 19); Common fungous diseases and their treatment" by W. C. Sturgis (Conn., No. 115); "Preventive treatment for apple scab, downy mildew and brown rot of the grape, potato blight and the smut of wheat and oats" by E. S. Goff (Wis., No. 34); "Black rot of the grape" by R. H. Price (Texas, No. 23). Bulletin No. 49 of the Cornell Station upon "Sundry investigations of the year" contains a short article on "Golden rod weeds" by A. N. Prentiss, two fungous diseases are described by G. F. Atkinson, and L. H. Bailey writes about a new maize and some egg-plant crosses.

THERE ARE TWO stations in Italy for the economic investigation of plant diseases,as we learn from an article by L. Paperelli,in the *Experiment Station Record* (iv, 233). One is the royal Station and Laboratory of Cryptogamic Botany at Pavia, established in 1871 in connection with the Botanical Institute of the Royal University. The director is Prof. G. Briosi, who has a special assistant for the station work. The income is about $2,000. The laboratory is also used for students in connection with the University. The other is the Royal Station of Vegetable Pathology at Rome, established in 1887. The director is Prof. G. Cuboni, who has two assistants. The income in 1891-'92 was $2,600. They are required to investigate the nature and cause of diseases, test and provide remedies, and disseminate information by lectures and publications.

TWO PAPERS on carnation diseases were read before the American Carnation Society at its annual session in Pittsburg during the last week in February, both of which are printed with many illustrations in the *American Florist* for Feb. 23d. One was by Prof. Geo. F. Atkinson, of Cornell University, who treated of rust (Uromyces caryophyllinus),spot (Septoria Dianthi), anthracnose. (Volutella sp.), rosette (Fusarium sp.?), and fairy ring spot (Heterosporium echinulatum). The development of the fungi producing these diseases is very fully described, including the behavior of part of them in gelatine culture. Illustrations are also given of a Cladosporium and a Botrytis which injure carnations. The other paper was by Prof. B. D. Halsted, of Rutgers College, describing spot, anthracnose, leaf mold (Cladosporium sp.), and a bacterial disease. A considerable part of the paper was devoted to remedies and means of controlling the several diseases.

THE PROCEEDINGS of the American Association for the Advancement of Science for the meeting at Rochester, August, 1892, has lately been distributed. It is a volume of 380 pages mostly devoted to the addresses of the officers, reports of committees, and abstracts of papers read. There are twenty-four botanical papers, represented by abstracts of about half a page each, and fifteen titles without even abstracts. There are several biological articles of as much interest to botanists as to those to whom they were especially addressed. Of these may be mentioned *Heredity of acquired characters*, by Manly Miles; *Comparative physiology of respiration*, by Simon H. Gage, and *Micro-organisms of the soil*, by Alfred Springer, the two latter being vice-presidential

addresses. The address of the retiring president, Albert B. Prescott upon *The immediate work in chemical science* is filled with important suggestions and almost as applicable to botany as to chemistry.

In a long paper in the March number of the *Annals of Botany* Dr. D. H. Scott and Mr. George Brebner discuss the secondary tissues in three genera of the shrubby monocots, namely, *Yucca*, *Dracæna*, and *Aristea*. They first reinvestigated the vexed question regarding the mode of origin and growth of the tracheides of Yucca and Dracæna. This question is mainly concerned with the point as to whether these secondary tracheides arise from the growth of a single cell, which consequently would have to push its way between other already formed cells much as the hypha of a fungus might, or whether the tracheides are formed by the fusion of several cells standing end to end. These investigators fully agree with the researches of Krabbe and Röseler, concluding that "the tracheides are formed by longitudinal growth only, each tracheide arising from a single cell, which may grow to thirty to forty times its original length, but remains uninucleate throughout its whole development." Further: "As the secondary tracheides are formed in a region which has ceased to grow in length, their development is entirely by sliding growth. . . . there can be no doubt that the development of the tracheides in the primary bundles is similar, but as the latter are formed in a region which is still lengthening as a whole a proportionately smaller amount of sliding growth is involved.

The studies of these gentlemen on the structure of *Aristea corymbosa*, one of the four known shrubby members of the great order Irideæ, have established the fact that this species "in common no doubt with the few other shrubby species of Irideæ, forms an indefinite amount of secondary tissue by means of cambium which continues active during the whole life of the plant. The tissue formed centrifugally, on the inner side of the cambium, consists of secondary concentric bundles, imbedded in ground tissue; on the outer side of the cambium a large amount of secondary cortex is formed. The latter is wholly parenchymatous." The authors point out that there is a remarkable agreement between the three groups of monocots in which secondary thickening occurs, and they hold that this peculiarity has arisen independently in each of the three. They add: "It is very probable that the first origin of secondary growth may be taking place in some of the monocotyledons at the present day, just as we find medullary bundles appearing in certain dicotyledons as an individual peculiarity."

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